SIGNAL AND TRAIN CONTROL

Introduction

From July 1 through August 22, 1997, approximately 17 FRA Signal and Train Control (S&TC) Inspectors conducted a safety audit of the CSXT signal system. They inspected 1,050 signals, 370 switches, 146 highway-rail grade crossing signals, and 726 miles of pole line.

In areas where S&TC Inspectors focused their inspections, automatic block, traffic control, and interlocking signal systems governed and supplemented the safety of train movements. The traffic control and interlocking systems were operated predominantly from a centralized dispatching center located in Jacksonville, Florida. According to the CSXT Signal Systems Annual Report for 1997, entitled "Method of Operation," CSXT has 10,385 track miles designated as Traffic Control System (TCS). Included within this system are 2,113 controlled points, 2,075 electric switches, and 38 electro-pneumatic switches. CSXT also maintains 148 remotely controlled, 106 automatic, and 29 manually operated interlockings. A total of 2,637 track miles is designated as Automatic Block System (ABS) and 109 miles as Automatic Cab Signal System (ACS). In addition, CSXT maintains approximately 10,000 highway-rail grade crossing warning systems. CSXT plans to install and/or upgrade approximately 350 systems in 1997.

Overall, FRA has concerns about the prevalence of false proceed signal failures, near collision incidents involving trains and other rolling stock, highway-rail grade crossing accidents, grade crossing signal activation failures, and false activations.

Concerns, Discussions, and Recommendations

Concern: Staffing and Supervision

FRA S&TC Inspectors raised concerns that CSXT does not have adequate field supervision and/or staffing at various locations.

Discussion:

FRA Inspectors are concerned that CSXT signal supervisors have insufficient time to devote to their main objectives (*i.e. supervising, instructing and training signal employees*) due to paperwork, general railroad policy meetings and other duties. These overall concerns are substantiated by high defect ratios of signal systems in many areas.

FRA noted locations where signal maintenance employees reported the supervisor did not inspect their work periodically regarding quality. Additionally, they reported that supervisors did not always have adequate time to fulfill all of their supervisory duties. This concern was supported by the fact that some CSXT signal maintenance employees failed to demonstrate to FRA Inspectors the proper procedures for troubleshooting, testing, and maintaining signal equipment on their assigned territories.

Concern was expressed that CSXT appeared to have inadequate staffing levels at various locations. This was reflected by the low level of signal maintenance performed because of job vacancies, signal employees on sick or vacation leave without proper relief employees available, one employee covering two territories, etc.

Recommendations:

- CSXT managers should reallocate a portion of the signal supervisors' non-supervisory duties to other staff.

- CSXT should review and evaluate supervisory and staffing levels in the signal department, to identify additional staffing needs and develop a plan to increase staffing levels where needed.

Concern: Pole Line

FRA found many sections of pole line which were not maintained properly in compliance with FRA regulations.

Discussion:

Pole lines carrying signal circuits must be properly installed and maintained to allow for the proper functioning and safe operation of any signal system. Wires should be properly tied to insulators, broken insulators should be replaced, and missing or broken cross arms and poles also should be replaced as needed. Of all signal system components inspected by FRA, pole lines had the highest incidence of defects and were most in need of repair or replacement. Many poles and cross arms were deteriorated to the point that a major commitment to either rebuild or eliminate them was needed as soon as possible. FRA found numerous unsecured signal line wires, thick vegetation interfering with wires, and broken poles. FRA learned that CSXT Signal Maintainers had been reporting these problems for quite some time.

These defective pole line conditions have the potential for causing or contributing to the cause of serious accidents, including collisions, due to false proceed signal indications. One such false proceed signal failure, caused by defective pole line conditions, occurred during the SACP review. This signal failure occurred on the approach to an interlocking where the Indiana Subdivision and Hoosier Subdivision intersected, but fortunately did not result in an accident.

FRA noted that CSXT had replaced sections of pole line with electronic-coded track equipment at various locations on its system. FRA also noted that in some locations where pole line rehabilitation work had occurred in recent years, the pole line was still in generally good condition.

Recommendation:

CSXT should survey all signal pole lines on its system; then, CSXT should develop a plan and timetable to repair substandard pole lines or replace them with underground cable or coded track circuits.

Concern: Insulated Rail Joints

FRA found many defective insulated rail joints, which were not in compliance with FRA regulations.

Discussion:

Federal regulations (49 CFR Part 236) require insulated rail joints to be maintained in such condition as to prevent energy from flowing between adjacent track circuits. Defective insulated rail joints can cause a variety of unsafe conditions. For example, a signal may abruptly turn red as a train closely approaches it, causing the train to make an emergency stop. As additional examples, false proceed signals may occur, or highway-rail grade crossing signals may falsely activate or fail to activate.

Insulated rail joints were found to be inadequately maintained at many locations. The CSXT signal department's trouble ticket database indicated that during the period of April 1, 1997 to July 31, 1997, 388 signal failures occurred as a result of defective insulated rail joints. FRA Inspectors noted conditions such as joints bridged by metal tie plates and missing end-posts with rail ends connecting. FRA is concerned that Maintenance-Of-Way personnel may not be aware of the importance of repairing defective insulated rail joints to prevent signal system malfunctions. A proactive policy which would allow for prompt correction of any insulated joint known to be defective is needed.

Recommendations:

- CSXT should develop a program in which all Signal Maintainers and signal supervisors are instructed as to the proper method of verifying defective insulated rail joints. FRA recommends that this program enhancement be considered and addressed by the Quality Action Council (QAC) for further input and refinement.

- All CSXT Roadmasters should receive instruction that defective insulated rail joints are to be considered a high priority repair item.

Concern: Preview of Signals

Poor preview and visibility of several wayside signals exists due to broken or soiled signal lenses, low lamp voltage, misaligned signal heads, and/or overhanging vegetation.

Discussion:

Safety information is conveyed by a wayside signal system through the engineers' ability to view the aspect of each signal. FRA found locations on CSXT where the preview of wayside signals was inadequate. The problems associated with signal previewing are compounded when inclement weather further impedes the Locomotive Engineer's viewing of wayside signals.

Signal lenses should be properly maintained and replaced as needed. Dirty or soiled signal lenses may create a hazard to train crew members who depend on adequate preview of signals. Severely cracked lenses create the risk of a signal aspect being mistaken for something other than intended, due to light refraction. Either situation may lead to unsafe and/or undesirable events and requires correction as soon as possible.

The CSXT standard for lamp voltage appears to be adequate; however, field testing is needed to ensure correct voltage levels are being maintained.

On almost every subdivision, there were one or more signals whose preview was obscured by overhanging vegetation. Wayside signals which are burning brightly but have their preview obscured by vegetation or other defective conditions inhibit the safe and efficient movement of trains.

Recommendations:

- CSXT should form a Signal Preview Team for each subdivision. These teams should perform head-end train ride observations and collectively decide if any signal previews need improvement. The appropriate signal supervisor or Road-master should receive written documentation of specific signals identified as having poor preview. The supervisor or Roadmaster then should take prompt corrective action.

- CSXT also should issue instructions to Signal Maintainers to inspect each wayside signal on their territories to ensure that correct lamp voltage, proper alignment, and adequate preview are maintained.

Concern: Recording of Tests and Inspections

FRA found that test and inspection records were not always accurately and/or completely recorded on test forms.

Discussion:

Employees should record all required tests and inspections on the railroad's prescribed forms. The forms must indicate the date of the test, be signed by the employee making such tests, and be filed by the appropriate supervisory personnel.

During recent inspections, FRA determined that CSXT needed to improve compliance with record-keeping requirements for signal tests. Specific problem areas included the following:

- The CSXT signal department's test records did not list the complete date of the tests. It has been, and continues to be, FRA's policy that a complete test date be recorded on test records, *i.e.*, Month/Day/Year. When a specific test takes longer than one day to complete, the date the test is completed should be shown as the date of the test.

- Currently, CSXT testing procedures do not require Signal Maintainers to activate flashing lights during ground tests. This procedure is required by 49 CFR 234.249. (When Maintainers fail to flash the lights, they may overlook a ground in the light circuit due to a open circuit condition such as burned out bulbs, open conductors, etc.)

- The CSXT test form and instructions for the testing of timing devices do not include a requirement for Maintainers to record the predetermined time interval (plan time); only the actual time measured is recorded. FRA's letter of interpretation, dated November 21, 1996, requires the predetermined time to be listed on the test form.

Recommendations:

- CSXT should revise the timing device forms to include a column for recording the predetermined time as well as the actual time measured.

- CSXT should modify its instructions for performing monthly ground tests on highway-rail grade crossing signals to include the required system and light activation.

- CSXT should assign signal staff to review signal test and inspection records so that general defective items such as improper dates, lack of signature, incomplete information, etc., can be corrected promptly.

Concern: Circuit Plans

FRA found locations where CSXT's signal circuit plans were incorrect, illegible, or missing.

Discussion:

Plans are necessary for the installation, inspection, maintenance, and repair of signal systems. To be in compliance with Federal signal regulations, CSXT must maintain an accurate and legible circuit plan, which reflects existing signal layout and design, at each signal location.

FRA found locations on CSXT where circuit plans were incorrect, illegible, or missing. FRA also found locations where outdated circuit plans were retained, in addition to the updated correct version. This leads to confusion and is not advisable. Because of the potential for errors in connections, FRA emphasizes the need to maintain legible and correct circuit plans at each signal location.

Recommendations:

- CSXT should thoroughly review and evaluate signal circuit plans for each subdivision to identify illegible and incorrect circuit plans.

- CSXT should develop a plan schedule to revise or replace outdated and incorrect circuit plans.

Concern: Poor Visibility of Flashing Light Signals

Flashing light units are to be inspected for alignment yearly in accordance with 49 CFR Part 234, and monthly in accordance with CSXT TC SRI 31.0. FRA Inspectors found crossing locations at which light units were not aligned to provide a clearly visible warning to approaching highway users.

Discussion:

There is much disparity in how warning system signals at highway-rail grade crossings should be aligned. FRA agrees that there is no one rule that applies to all situations, but FRA believes that the field alignment process at some locations on CSXT does not meet the requirements of 49 CFR Part 234.217, which states that flashing lights shall be positioned and aligned to be visible to highway users approaching the crossing.

The lamp voltage for each lamp in flashing light units should be maintained at 85 percent of the prescribed lamp rating. Low voltage on the flashing light units was also a major concern of the inspection teams. In multiple locations, the DC voltage at the flashing light unit fell well below the FRA requirement, due to lack of standby battery capacity and/or other factors. It was apparent that not all Signal Maintainers were knowledgeable about the method of setting flashing light lamp voltages to meet CSXT and FRA requirements.

FRA found several crossing locations at which the preview of the active warning devices was obstructed by various highway-related objects. Vegetation, telephone poles, signs, and other such objects that obstructed the preview of warning devices at grade crossings were often located off railroad property.

Recommendations:

- CSXT should provide instructions for highway-rail grade crossing signal maintenance that correspond to FRA regulations and AAR guidelines.

- CSXT should assure that a signal inspection team, specializing in highway-rail grade crossings, is formed on each subdivision. These teams should review all highway-rail grade crossings to identify those in need of repair or upgrade.

- CSXT should develop a plan or schedule to repair, upgrade, or replace grade crossing signals, as needed to comply with current regulations.

Concern: Rusty Rail Conditions

FRA is concerned about the existence of rusty-rail-related conditions, which can cause or contribute to accidents/incidents.

Discussion:

The key basic component of signal systems is the track circuit. If the track circuit does not detect the presence of locomotives or rail cars, chances increase that false proceed signal indications or grade crossing signal failures will occur. These conditions could result in serious accidents.

If the track rails are not in condition to detect the presence of train wheel shunting, adequate measures to safeguard train operation must be taken. When it is obvious to field personnel that excessive rust or other rail-contaminating conditions exist, or if they view a situation where track circuit shunting is not effective due to rusty or contaminated rail, CSXT should have a procedure in place for employees to report and handle such problems.

Recommendations:

- CSXT should issue instructions that advise field signal personnel of the potential problems associated with rusty or contaminated rail, and establish procedures (and requirements) to inspect, report, and repair rusty rail conditions in a timely manner.

- CSXT also should instruct all Signal Maintainers to canvas their territories, immediately report any rusty rail conditions, and take appropriate corrective action.

Concern: Red-Tagged and/or Unsafe Signals

FRA found that some wayside signals were inaccessible for testing and maintenance because they were unsafe to climb.

Discussion:

Title 49 CFR Part 236 requires test and inspection of semaphore and searchlight signal units. All signals require periodic maintenance and repair. In cases of reported signal malfunctions, immediate access to the upper extremities of the signal unit may be required to allow for repair, without undue delay.

In areas where signals are known to be unsafe to climb, potentially unsafe signal conditions could exist for long periods of time. It was noted that several semaphore signals, which depend on illumination of lamps for night train operation, have not been repaired because the signal was unsafe to climb. In addition, some semaphore signals and searchlight signals which require periodic inspection and testing were not being tested within the time requirements of 49 CFR Part 236.102.

CSXT suggested the use of hi-rail bucket trucks as a method to access the upper extremities of red-tagged signals. FRA noted that railroad personnel often had to wait long periods of time on bucket trucks for each trouble call involving red-tagged signals, not the most efficient way to use resources and provide adequate maintenance.

Recommendation:

CSXT should take immediate action to identify all unsafe signals and/or signal ladders, and develop a plan to replace them without undue delay.

Concern: Power and Hand-Operated Switches

FRA found hand and/or power-operated switches that did not meet FRA's minimum standards.

Discussion:

FRA found loose and ineffective rail braces and associated switch fasteners, rails not properly anchored, and defective head block ties which allowed excessive movement of switch components. Switch rail fastenings, switch plates, and rail braces must be properly maintained and kept securely in place to mitigate any excess movement in the area of switch points. Rail must be adequately anchored to prevent excessive rail movement which will have an adverse effect on switch contact adjustment. The track should be in correct surface and alignment throughout the switch point and turnout area to prevent switch indication circuits from pumping intermittently. Signal Maintainers should be alert for defects which may affect switch contact adjustment, and should notify their supervisors of any problems which cannot be corrected, or for which additional help is needed.

Recommendations:

- CSXT should re-emphasize existing instructions to field maintenance employees regarding joint switch inspections by Signal Maintainers and Track Inspectors.

- CSXT should develop a training program for track department personnel to learn switch maintenance requirements and the relationship of track conditions and switch point adjustment and movement.

Concern: Testing Time for Signal Maintainers

Some CSXT signal employees are not receiving adequate time from the Train Dispatcher to complete all required tests and inspections due to train traffic density, an increase in the number of signal units, an increase in the number of trouble calls, and the existence of programmed track gangs on the territory.

Discussion:

The testing time for Signal Maintainers has become a significant issue over the past several years for the reasons mentioned. While all railroads need to continue to operate trains without unwanted delay, they need to build in time for periodic testing of vital signal systems, to operate safely.

Recommendation:

FRA, the Brotherhood of Railway Signalmen, and CSXT have agreed to form a team to study and analyze time issues and the Maintainer's actual work environment in an effort to provide as much quality testing time to the Signal Maintainers as possible. CSXT should continue to analyze and improve conditions in the area of testing and work time for signal employees.

Concern: Enhancements Needed For The Existing Training Program

FRA believes that not all aspects of the signal training program are reaching all field personnel. In addition, it appears that some CSXT signal employees are experiencing difficulty applying classroom subject matter to on-the-job situations. FRA also has a concern that training classes for less experienced signal employees do not focus on basic signal maintenance principles.

Discussion:

FRA noted a very good Train-the-Trainer program in place on CSXT. However, the program is somewhat lacking in the area of on-the-job training and follow-up field verification. Adequate supervisory follow-up would ensure that CSXT signal employees completely understood the subject matter and could demonstrate their knowledge in real testing situations.

FRA also noted a very good Hours of Service training program in place on CSXT, with almost all signal employees and management staff having received the training. FRA had engaged in a joint training partnership with CSXT, which has resulted in a dramatic

decrease in incidents where CSXT signal employees had exceeded the 12-hour threshold

during the past 12 months.

Overall, FRA recognized that CSXT has a training program which appears to be adequate in the area of printed procedure and documentation; however, FRA is concerned that all aspects of the training program may not be reaching all field personnel. A personal training data base which tracks the individual training history of each employee has been implemented recently. This data base has been made available to supervisors to track their employees' training progression and requirements.

Due to the influx of new employees and the rapid placement of these employees in Maintainer jobs, and signal maintenance and construction crews, training classes need to be very basic. FRA noted that new employees who were placed in Signal Maintainer jobs sometimes lacked the very basic concepts and maintenance practices necessary for day-
to-day signal system maintenance. For example, many were unable to properly troubleshoot basic track circuit problems, test battery and/or battery chargers, or demonstrate the procedure for adjusting point detectors of power and hand-operated switches.

On-the-job training can be a very effective training method; however, new employees need to have access to supervisors or trainers. With a trainer present, employees are more comfortable adjusting and testing signal equipment without the fear of creating an unsafe or train-delaying condition. In order for this on-the-job process to work, signal supervisors or trainers need to spend more time in the field working directly with their employees.

Recommendations:

- **!** CSXT should continue using the new personal training data base to track the training history of each signal employee.

- **!** Supervisors should identify employees who may be having trouble applying or fully understanding certain subject matter. They then should arrange one-on-one training sessions, including a testing period and field demonstration.

- ! CSXT should develop a course agenda for new signal employees which stresses basic signal system installation and maintenance, and covers topics such as track

circuits, battery maintenance, basic switch adjustment and maintenance (power and hand-operation), and basic highway-rail grade crossing signal maintenance.